Original Article

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Anaesthesia Section

Comparison of Airtraq with Macintosh Laryngoscope for Endotracheal Intubation in Paediatric Patients: A Randomised Controlled Trial

YOGITA DWIVEDI[1], ANKIT JAIN[2], VIJAY PRATAP YADAV[3], ATIHARSH MOHAN AGARWAL[4]

ABSTRACT

Introduction: The Airtraq is a new intubation device that has been developed to facilitate tracheal intubation in patients with normal or difficult airway. The available paediatric sizes are 0, 1 and 2 and are of grey, purple, green colour. These can insert endotracheal tube of size 2.0-3.5/4-5.5/6-7.5, respectively.

Aim: To evaluate the clinical efficacy of Airtraq laryngoscope in comparison with Macintosh by experienced Anaesthesiologist for intubation in paediatric patients.

Materials and Methods: The randomised controlled trial was conducted at Sarojini Naidu Medical College, Agra, Uttar Pradesh, India, from December 2015 to August 2017. Fifty healthy children, aged 2-10 years of American Society of Anesthesiologists (ASA) grades I/II, presenting for elective surgery were randomly allocated in two equal groups. Endotracheal intubation was done either using Airtraq or Macintosh laryngoscope. Duration of intubation (primary variable), number of attempts, ease of intubation, oesophageal intubation, optimisation maneuvers, Percentage Of Glottic Opening (POGO) scoring and haemodynamic parameters were compared between two groups. Patients' demographic data, intubation time, haemodynamic variables were analysed by Unpaired t-test. While number of attempts for intubation, ease of intubation, optimisation maneuvers and POGO scoring were analysed by Fisher's-exact test. Data was presented as mean±SD with categorical data presented as frequency (n) and percentages (%). The p-value of <0.05 was considered as significant.

Results: There was no difference in demographic variables and duration of surgery between two groups. Intubation time, which was taken as primary variable, was found to be significantly longer in Macintosh (56.28±6.02 sec) as compared to Airtraq (25.60±3.73 sec) with p-value <0.0001. In terms of ease of intubation and POGO scoring, Airtraq was better as compared to Macintosh. Haemodynamically, Airtraq was found to be better as compared to Macintosh reflected by postintubation heart rate which was 110±7.84 beats/min with Airtraq while 119.32±10.61 beats/min with Macintosh (p-value=0.0028). The two groups were statistically comparable in terms of number of attempts, optimisation maneuvers and mean blood pressure changes.

Conclusion: It can be concluded that Airtraq is a reliable and promising alternative to Macintosh for endotracheal intubation in paediatric patients as seen by duration of intubation, better laryngeal view, ease of intubation and haemodynamic changes.

Keywords: Airway, Glottic opening, Indirect laryngoscopy

INTRODUCTION

The Airtraq (Prodol Meditec SA Vizcaya, Spain 2005) is a new intubation device that has been developed to facilitate tracheal intubation in patients with normal or difficult airway. It is available in sizes 0, 1 and 2 and is of grey, purple, green colour and can insert endotracheal tube of size 2.-3.5/4-5.5/6-7.5, respectively [1]. It was developed by Pedra A Gandarias. It has an exaggerated curvature of the blade and contains a series of lenses, prisms and mirrors that transfer the image from the illuminated tip to a proximal view finder. A view of the glottis is provided without alignment of the oral, pharyngeal and laryngeal axis [1]. The head and tongue of a child are larger, epiglottis is floppy, omega-shaped and located at higher level, larynx is funnel shaped and narrowest part is subglottic region while in adults, it is at level of vocal cords. They have limited oxygen reserves and high oxygen consumption [2]. Airway gadgets used in management of paediatric airway are limited. Video-laryngoscopes have limited utility as they prolong intubation time and high failure rates [3].

Previous studies comparing use of Airtraq with Macintosh laryngoscope concluded that Airtraq has easy learning curve and provides superior intubating condition in adults [4,5]. But, due to difference in airway anatomy, these results cannot be extrapolated in paediatric population. It was hypothesised that intubation with Airtraq would provide superior intubating conditions as compared to Macintosh blade.

This study was conducted to compare intubation time, Percentage Of Glottic Opening (POGO) scoring, success rate of intubation of Airtraq with Macintosh laryngoscope, which is most commonly used in paediatric population.

MATERIALS AND METHODS

The randomised controlled trial was conducted after approval of Hospital Research Ethical Committee (letter no. Anaes\231\2015) at Sarojini Naidu Medical College, Agra, Uttar Pradesh, India, during December 2015 to August 2017. Informed and written parental consent was taken for each participant.

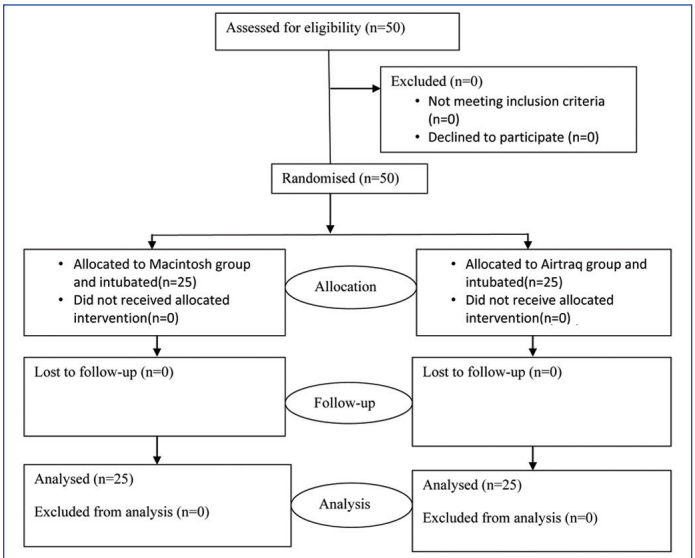
Inclusion criteria: Total 50 healthy children aged 2-10 years of American Society of Anesthesiologists (ASA) grade I/II, who were scheduled for elective surgery under general anaesthesia requiring endotracheal intubation were included in this study.

Exclusion criteria: Subjects with history of upper respiratory tract infections, cardiovascular and central nervous system disease, risk of gastric aspiration, respiratory problems or difficult airway were excluded from the study.

Sample size calculation: Sample size estimation was based on the primary outcome namely intubation time. Power of study as 80%, alpha error as 0.05, and beta error at 0.2 minimum. Twenty five subjects per group were considered, based on 25 seconds (50%) reduction in the intubation time comparing Airtraq with Macintosh laryngoscope.

Procedure

Solid food was not allowed for 8 hours preoperatively and clear liquids were permitted up to 2 hours prior to induction of anaesthesia. Fifty patients were equally randomised into 2 groups Airtraq and Macintosh of 25 each, using sealed envelope by an anaesthetist not involved in the study [Table/Fig-1].



[Table/Fig-1]: CONSORT flow chart.

After shifting the patient to the operation theatre, intravenous (i.v.) access was obtained. Five lead Electrocardiogram (ECG) was connected, pulse oximeter, temperature and non invasive blood pressure monitor attached and baseline parameters were recorded. After preoxygenation with 100% oxygen for 3-5 minutes, midazolam 0.02 mg/kg, glycopyrolate 0.005 mg/kg and fentanyl 2 µg/kg was given 1-2 minutes before induction. A sleep dose of propofol (2-3 mg/kg) was titrated to induce anaesthesia. Patients in whom bag and mask ventilation was possible were given atracurium 0.5 mg/kg over 60 seconds and laryngoscopy was done after 2 minutes. Trachea was then intubated by anaesthetist experienced in the use of both laryngoscope (at least 30 intubations with each prior to data recording). Correct placement of tracheal tube was confirmed by capnography and bilateral chest auscultation. Thereafter, the lungs were mechanically ventilated for the duration of surgery and anaesthesia was maintained with isoflurane (0.6-1%) in a mixture of nitrous oxide and oxygen in 3:1 ratio and atracurium 0.1 mg/kg. No other medication was administered or procedure performed during the 3 minutes of data collection period after the tracheal intubation. Residual neuromuscular blockade was reversed with neostigmine 40 mcg/kg and glycopyrrolate 10 mcg/kg.

Either of the two laryngoscopes was selected for intubation, based on the group allocated. A blade of 1 or 2 of standard Macintosh blade was selected in according to preference of the anaesthetist. Paediatric size (size 1/2) Airtraq was chosen and appropriate size endotracheal tube was attached to it. The view of glottis at laryngoscopy was scored according to POGO scoring. Glottic view scoring was done after primary visualisation of glottis. A maximum of 3 attempts were allowed before considering intubation as failed one. Any loss of visualisation due to "fogging" or "red-out" was recorded.

Parameters Assessed

Primary outcome:

1. Intubation time (time recorded from termination of manual ventilation with a facemask to visible chest rise and appearance of CO_2 trace in monitor). Intubation requiring more than 120 seconds was considered as failed intubation.

Secondary outcome:

1. Success rate of intubation (first attempt success was correct placement of the tracheal tube within 60 seconds without oxygen saturation below 94% during the attempt) [6].
2. Number of attempts (a maximum of three attempts were taken before considering it failed intubation)
3. Ease of intubation (measured by visual analog scale from 1-10, 10 means most difficult or failed intubation and 1 mean very easy intubation)
4. Number of oesophageal intubation
5. Optimisation maneuvers required to perform tracheal intubation (0-No maneuvers required, 1-External Laryngeal pressure, 2-Use of a stylet)
6. Haemodynamic changes (change in heart rate, systolic blood pressure, diastolic blood pressure)
7. POGO scoring (denotes visual estimation of laryngeal opening in score of 0-100%, 0-none of the glottic opening is seen, 100-full visualisation of larynx from inter arytenoids notch to anterior commissure of vocal cords) [7].

STATISTICAL ANALYSIS

Patients' demographic data, intubation time, haemodynamic variables were analysed by Unpaired t-test. While number of attempts for intubation, ease of intubation, optimisation maneuvers and POGO scoring were analysed by Fisher's-exact test. Data was presented as mean standard deviation with categorical data presented frequency (n) and percentages (%). The p-value of <0.05 was considered as significant using Statistical Package for the Social Sciences (SPSS) software version 13.0 and statpages.org for analysis.

RESULTS

There was no difference in demographic variables and duration of surgery between two groups [Table/Fig-2]. Total 50 paediatric patients were included in the study and no failed intubation was seen in both the groups. Intubation time was taken as primary variable and it was found to be significantly longer in Macintosh group as compared to Airtraq group with a p-value of <0.0001. In terms of ease of intubation, mean VAS scores was better for Airtraq as compared to Macintosh mean with a p-value of 0.01 [Table/Fig-3].

Variables	Airtraq	Macintosh	p-value
Gender (male/female)	12 (48%)/13 (52%)	13 (52%)/12 (48%)	0.78
Mean age (years)	5.33±2.67	5.08±2.69	0.74
Mean weight (kg)	21.50±7.96	21.58±7.83	0.96
Duration of surgery (min)	56.48±14.29	55.92±12.43	0.88

[Table/Fig-2]: Demographic data.
Data represented as Mean±SD or number (percentage) continuous data compared with Unpaired t-test

Parameters	Airtraq (n=25)	Macintosh (n=25)	p-value
Overall success rate (n%)	25 (100%)	25 (100%)	-
Intubation time (sec) (mean±SD)	25.60±3.73	56.28±6.02	<0.0001*
Number of attempts (1/2/3/failure)	24/1/0/0	23/2/0/0	0.6173
Optimisation maneuvers (0/1/2)	23/2/0	22/3/0	0.1319
Ease of intubation {VAS (median, IQR)}	3 (2-3.5)	5 (3.5-6)	0.01*
POGO score {median (IQR)}	100 (93-100)	75 (66-100)	0.04*
Airway trauma (dental injury\blood on laryngoscope)	1/25	2/25	0.61
Heart rate (beats/min) (mean±SD)			
Baseline	106.64±9.35	106.72±11.14	0.9782
1 min (postintubation)	114.16±7.19	113.84±11.04	0.9039
3 min (postintubation)	110.96±7.84	119.32±10.61	0.0028*
Systolic blood pressure (mean±SD) mmHg			
Baseline	111.12±10.35	109.72±9.70	0.467

1 min (postintubation)	110.52±11.84	117.76±6.89	0.0118*
3 min (postintubation)	110.86±6.84	120.22±10.71	0.0027*
Diastolic blood pressure (mean±SD) mmHg			
Baseline	69.76±7.22	66.88±7.64	0.17
1 min (postintubation)	73.44±7.26	69.00±8.59	0.054
3 min (postintubation)	71.40±8.48	72.64±6.51	0.56

[Table/Fig-3]: Comparison of various parameters between the groups.
*Statistically significant. POGO: Percentage of glottic opening; VAS: Visual analogue score; SD: Standard deviation
Intubation Time (IT), haemodynamic parameters compared by unpaired t-test
Number of attempts, optimisation maneuvers, VAS Score, POGO Score by Fischers-Exact Test

The mean POGO scores were 75 for Macintosh and 100 for Airtraq laryngoscope (p-value=0.04). Haemodynamically, Airtraq was found to be better as compared to Macintosh as reflected by heart rate and mean arterial blood pressure immediately and at 3 minutes after intubation [Table/Fig-3]. The two groups were statistically comparable in terms of number of attempts, optimisation maneuvers, mean blood pressure changes. Airway trauma (dental/lip injury, blood on laryngoscope) was less frequent with Airtraq but the results were not statistically significant.

DISCUSSION

Role of Airtraq as a rescue device in difficult airway in paediatric population is well-documented in Pierre Robins syndrome [8] and Treacher Collins syndrome [9]. However, its role in routine airway management is still debatable despite its portability, availability of smaller sizes, cost, and faster learning curve.

This study success rate of intubation with Airtraq and Macintosh laryngoscopes was 100% with no failed intubation with size 1 and 2 airtraq. However, other studies have found relatively higher intubation failure rates especially in infants intubated with Airtraq size 0 [6]. This has been attributed to the trajectory at which the endotracheal tube leaves the Airtraq which causes it to hit the posterior commissure leading to inability to pass the endotracheal tube despite good laryngeal view. To prevent this, the Airtraq device must be pulled anteriorly until the larynx appears at the center of the eyepiece. A slight lifting and rotation of scope can be useful maneuvers [6].

Intubation time with Airtraq was 25.60 seconds, which was less as compared to Macintosh with a p-value of 0.0001. Other studies [10,11], reported a difference in intubation time between two devices varying between 10 to 25 seconds in hands of novice and experienced anaesthesiologist. In the paediatric age group, Airtraq has shown to provide superior POGO scores with success rate similar to conventional laryngoscope but, this data is very limited [10,12]. Use of less optimisation maneuver, prefixed intubation channel, no axis alignment, better glottic visualisation with Airtraq, as compared with direct laryngoscopy, could be attributing factors for less intubation time with Airtraq laryngoscope [11,12].

In terms of ease of intubation, mean VAS scores were better for Airtraq as compared to Macintosh. Similar findings were reported by the present trial and other studies too [12]. The inbuilt fixed channel sometimes interferes with manipulations required during tube advancement. Sun Y et al., concluded that paediatric Airtraq is difficult to use in comparison to adults [3]. Endotracheal tube negotiation could be a problem which can be overcome by using an intubation stylet or a bougie.

Heart rate at 3 minutes after intubation in Airtraq group was found to be 110.96 while in Macintosh it was 119.32, with a p-value of 0.0028 that is statistically significant. Decreased duration of laryngoscopy and lifting force resulted in less stimulation of the periglottic sympathetic plexus with use of paediatric Airtraq laryngoscope [11,12].

Limitation(s)

Firstly, the potential for bias exists as, it is impossible to blind the anaesthesiologist to the device being used. Secondly, certain measurements used in this study are of subjective nature. Thirdly, this study was conducted by experienced user of both devices. The results may differ in the hands of less experienced users. Lastly, this study was conducted in patients of normal airway so, the results might differ when used in cases of difficult airway.

CONCLUSION(S)

On the basis of this study, it was concluded that, Airtraq size 1 and 2 laryngoscope can be added to the armamentarium of paediatric anaesthesiologist. Ease of intubation, excellent laryngeal view, lesser intubation time and reduced haemodynamic alterations are its key features.

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PARTICULARS OF CONTRIBUTORS:
1. Associate Professor, Department of Anaesthesia, Government Medical College, Azamgarh, Uttar Pradesh, India.
2. Senior Resident, Department of Anaesthesia, Sarojini Naidu Medical College, Agra, Uttar Pradesh, India.
3. Assistant Professor, Department of Anaesthesia, Government Medical College, Azamgarh, Uttar Pradesh, India.
4. Assistant Professor, Department of Anaesthesia, Government Medical College, Banda, Uttar Pradesh, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Yogita Dwivedi,
D-29, Pratap Nagar, Jaipur House, Agra, Uttar Pradesh, India.
E-mail: yogitadwivedi70421@gmail.com

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